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14. ABSTRACT
Funds from this grant were used to buy a continuous tunable laser source and electronics package that is being used for electrooptic modulation experiments in unique electrooptic fibers that are made in our laboratory. In addition, this proposed laser system compliments our present fiber characterization experiments that include linear absorption, scattering, refractive index, stimulated Brillouin scattering, quadratic electrooptic measurements, fluorescence, photobleaching, and photoisomerization.

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Final Report to AFOSR
High-Speed Polymer Fiber Electrooptic Modulators and Devices

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Grant Number: F49620-98-1-0275

Contents

1 Summary

Funds from this grant were used to buy a continuous tunable laser source and electronics package that is being used for electrooptic modulation experiments in unique electrooptic fibers that are made in our laboratory. In addition, this proposed laser system compliments our present fiber characterization experiments that include linear absorption, scattering, refractive index, stimulated Brillouin scattering, quadratic electrooptic measurements, fluorescence, photobleaching, and photoisomerization.

2 Research Areas

2.1 Electrooptic Fibers

Figure 1 shows a schematic representation of the cross-section of a single mode electro-optic fiber that we are now making in our laboratory. The core consists of a dye-doped polymer

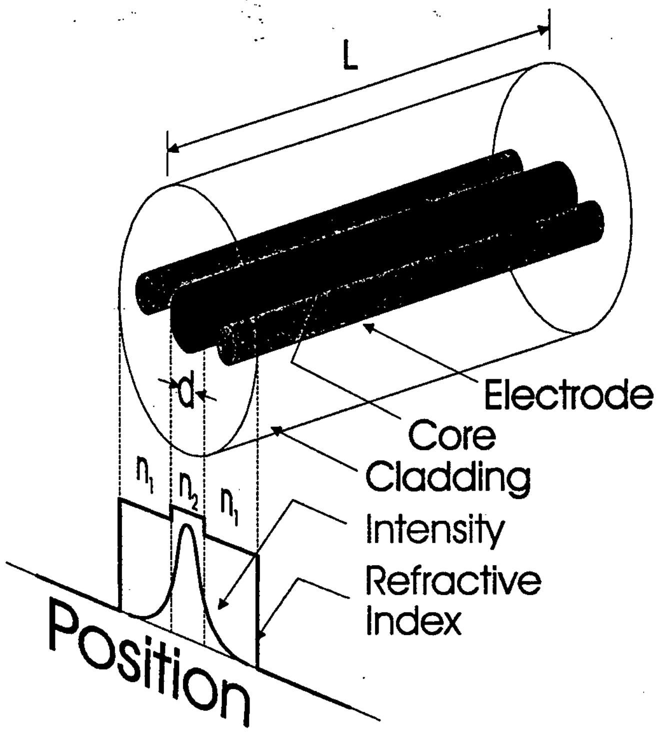

Figure 1: Cross-sectional view of a single-mode polymer optical fiber with embedded electrodes. The size of the core and electrodes has been exaggerated in this illustration.

which gives rise to the elevated refractive index and is the source of the nonlinearity. The indium electrodes are compatible with the low processing temperature which is required when using molecular dopants. The electrodes can be used both for poling the material and for electrooptic modulation.

2.1.1 Electrooptic Modulation

One major project in our laboratory that is funded by AFOSR and industry is aimed at making an electrooptic modulator in a polymer optical fiber. Such fibers need to be poled and their nonlinear-optical properties evaluated. Figure 2 shows a schematic diagram of our present electrooptic modulation experiment that has been used to demonstrate modulation in an electrooptic fiber.

2.1.2 Refractive Index

There are many methods for measuring the refractive index, which is an important material property that must be known to design single-mode waveguides. We have applied a series of refractive index measurements (using the new system) to a series of preforms of different compositions.

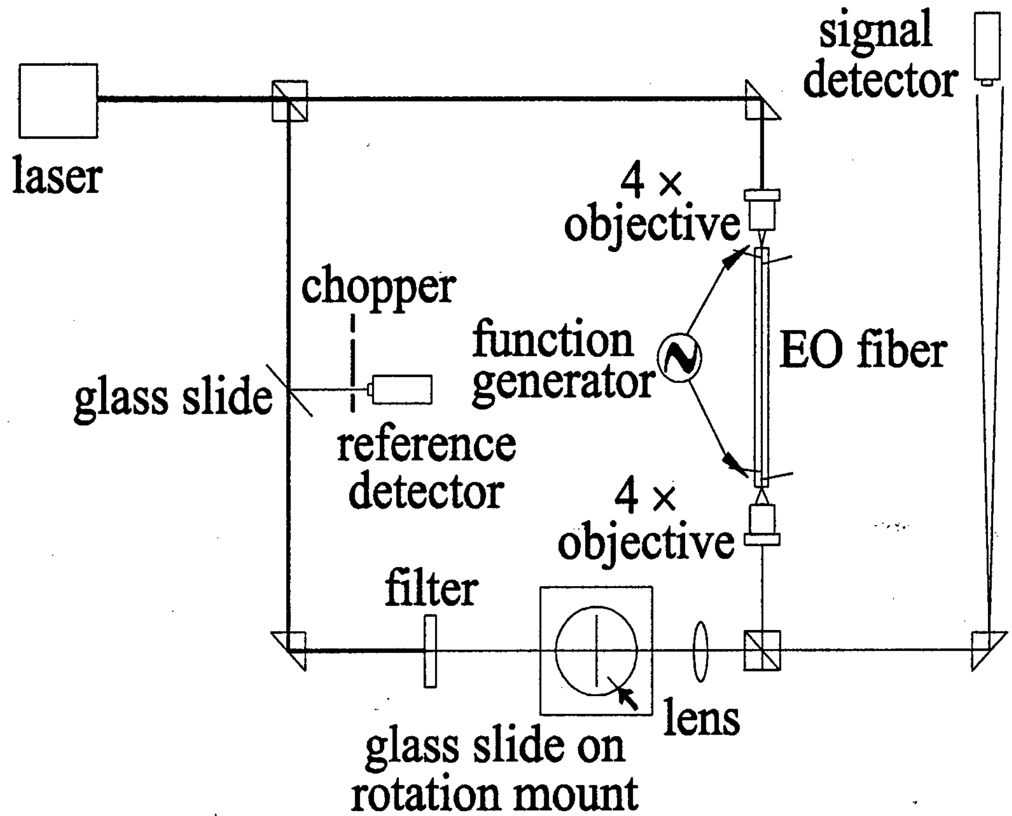

Figure 2: Experimental configuration for studying electrooptic modulation in an electrooptic polymer optical fiber.

2.2 Dual-Core Fiber

We have been making dual core fibers with the goal of making a nonlinear coupler. The new laser system is instrumental in getting the refractive index profile required to design the proper geometry for the required beat length.

2.3 Photobleaching

A recent measurement that has become important for evaluating material reliability. We have been using the new laser system to do highly accurate time-dependent photobleaching studies as well precise absorbance using a new technique that we have developed, which we call side-illumination fluorescence. We have been able to apply this technique to studying material reliability.

2.4 Quadratic Electroabsorption

We have been using the new system to measure both material optical nonlinearity using electroabsorption and electrooptic modulation in thin films as well as fibers.

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3 Research and Education

Our laboratory is DOD-funded for materials processing, characterization, optical device fabrication, and demonstration of all-optical waveguide devices. The acquisition of the proposed equipment impacts each area. It provides feedback from material characterization studies to processing and fabrication efforts. It also impacts the evaluation of all-optical switching devices that are designed and built in our lab. About one dozen students are in training at any given point in time. This includes undergraduates, Masters and Ph.D. students. The research program stresses multidisciplinary research that spans materials science, physics, and engineering. We have also hosted visiting scientists and collaborate with other departments and universities. The students are thus exposed to the modern paradigm of cross-discipline collaborative research.

One graduate student has received a Ph.D. in Physics and three additional students will get their graduate degrees (two Doctorates and one Masters) in the next semester who extensively used the new equipment purchased under this grant.

4 Related DOD Funding

We have been funded by AFOSR for all-optical device fabrication in polymer fibers and have had corporate STTR funding through ARO, NASA, and AFOSR for development of a variety of optical devices. Much of the work described above is related to AFOSR funding.

5 Purchased Equipment

Proposed Equipment Items:

Equipment Item	Vendor
Optical Table System	Mells-Griot
PC Computer System	TC Computers
Computer Interface	National Instruments
Tunable Continuous Laser	Coherent Inc.
Electronics	Various

A more detailed list is included as part of the Fiscal Report.

Final Property Report

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Agency Name: ONR
Award Number: F49620-98-1-0275
WSU Account Number: 12F-2464-0298
Date: December 2, 1999

DESCRIPTION / MANUFACTURER	ACCT	INVENTORY NUMBER	MODEL # SERIAL #	DATE AQUIRED	PO # VO #	TOTAL ITEM COST	PROJECT COST	TITLE VESTED IN	LOCATION
Laser System/Coherent Laser Group	06	355838	899 88824	6/25/98	159564 717204	$ 171,941.41	$ 161,619.84	WSU	PHYS 0726
Generator/Stanford Research System	16	355577	DS345 31388	6/3/98	163568 689226	$ 2,259.56	$ 2,259.56	WSU	PHYS 0724
Computer/Treasure Chest Computers	16	361883	Computer system	4/10/98	K158296 P658423	$ 1,671.60	$ 1,671.60	WSU	PHYS 0721
					TOTALS	$ 176,872.57	$ 165,551.00		

The equipment listed above was purchased in whole or in part with funds provided by the Agency listed above.
Title vests with Washington State University, without further obligation to the Government.

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Ted Mordhorst, Accounting Supervisor II

DATE

Refereed Publications resulting from DURIP Funding

- Z. Zhou, S. Vigil, B. Canfield, J. Tostenrude, and M. G. Kuzyk, "Dual-core single-mode nonlinear fiber coupler," JOSA B **15**, 895 (1998).
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- R. Kruhlak and M. G. Kuzyk, "Side Illumination Fluorescence (SIF) Spectroscopy I: Principles," J. Opt. Soc. Am. B 16, 1749 (1999).
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- M. G. Kuzyk, D. W. Garvey, S. R. Vigil, D. J. Welker, "All-optical devices in polymer optical fiber," Chemical Physics, **245**, 533 (1999).